The Files - RD 125, T.O. 9 31 March 1959

25X1A9a [redacted]

Trip Report - Traveling Wave Maser

1. On 19 March 1959 the undersigned and Mr. [redacted], SPS/EA, 25X1A
25X1A5a1 visited the [redacted] in Philadelphia, Pennsylvania to monitor
25X1A5a1 progress on the joint Agency-[redacted] program for development of a traveling wave maser. Participating in the discussions were:

25X1A5a1 [redacted]

[redacted] - SPS/EA
25X1A9a OC-E/R+D-EP

25X1A5a1 2. [redacted] plans to supply the necessary DC magnetic field to the maser with a niobium solenoid. Niobium was chosen as the conductor because of its superconductivity at temperatures near the proposed operating temperature of the maser. Preliminary experiments have been run on a solenoid 6" long, to determine the maximum field and the maximum current which the niobium can withstand before going into a non-superconductive state. Difficulties have been encountered in trying to reduce the resistance of the spot-weld joints connecting one of the three niobium wire layers to another. The high joint resistances begin to heat up when passing the high currents necessary for desired DC fields. The heat from these joints then destroys the superconductive state of the niobium. The final solution consisted of wrapping the joint with a foil made of KOVAR (a commercial alloy) before the spot welding operation. Joints made in this manner have a resistance of less than 10-5 ohms each, as compared to resistances of 10-3 ohms per weld which were obtained earlier in the program with conventional wire welding techniques. A new solenoid is now being constructed for the maser which will have five layers of 1 mil niobium. Length of the solenoid will be 17". It is expected that magnetic fields considerably in excess of the minimum required field (approximately 2000 oersteds, the figure around which the TWM was designed) will be obtainable from this solenoid.

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3. The cryostat to be used with the TWM will hold up to 3 liters of liquid helium. [redacted] reports that at 1.5°K the leakage rate of the
25X1A5a1 helium is no more than 85 cc/hour. One filling, therefore, should be good for a full day's operation. Once the assembled maser is actually being tested, the contractor estimates that the helium requirement will
25X1A5a1 be approximately 12 liters per week. An allotment for the needed quantity of helium was arranged by the Agency through [redacted] U.S. Department of the Interior, Bureau of Mines, Washington, D.C.

4. Absorption measurements at low temperature have already been made on the ruby which will go into the maser. These measurements indicate that the cutting was done to a remarkably high degree of precision, the resonances from the 4-3 transition and the 2-1 transition being almost perfectly coincident. This condition is absolutely necessary if the push-pull mode of operation is to be used. That mode in which both 4-3 and 2-1 transition frequencies are identical and can be used together as the signal frequency, and both 4-2 and 3-1 transition frequencies are identical and can be used together as the pump frequency, is called the push-pull mode. This mode permits a greater exploitation of the ruby's energy levels to achieve high power outputs.

25X1A5a1 5. [redacted] expects to have the TWM assembled and operating within a month. The ruby material will measure approximately 12 to 14 inches in length, thereby giving an effective amplifying length of 24 to 28 inches (signal travels through the ruby, is reflected, and travels back again, being amplified in both directions). The 17" solenoid will completely surround the ruby, furnishing a DC field of approximately 2000 oersteds for 6 kmc operation, or more for higher frequency operation. A 20 db gain should be realizable, and the noise figure will be well below 1 db. Noise temperature, although [redacted] does not have equipment to measure this characteristic, will probably range from 5 to 35 degrees Kelvin. The device should be tunable over a two to one bandwidth by adjustment of pump frequency and DC magnetic field. 25X1

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